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ABSTRACT: An examination of the client side of the Geographic Information
Systems (GIS) industry reveals a broad array of choices. The market
includes Environmental Systems Research Institute's (ESRI) ArcView, a
self-contained desktop geographic analysis **product** including more than a
gigabyte of map and socioeconomic information, and MapObjects, which
enables the integration of GIS functionality into custom applications being
created for Windows 95 and Windows NT. GIS has also been addressed by
 products from CAD vendors, including Bentley's MicroStation GeoGraphics
and AutoDesk's AutoCAD Map. Users of MicroStation Geographics can interact
with data in terms they understand. AutoCAD Map employs GIS topology such
as buffering, network analysis, and polygon overlay.
TEXT:
          TURNING THE TABLES TO EXAMINE THE CLIENT SIDE OF THE GIS INDUSTRY.
     In our November 1996 issue, I surveyed Geographic Information Systems
(GIS) technology and the industry that has sprung up around it during the
last half decade. I reviewed the nomenclature of GIS and the problems that
it is suited to solve, as well as the recent GIS initiatives of the major
database vendors. This month I switch focus to the client side of the GIS
business. First I acquaint you with **products** from companies whose primary
mission is to serve this marketplace. (That discussion will consider
horizontal GIS **products** that can address a wide variety of application
scenarios, as well as a few niche **products** that solve some very
interesting database problems.) Next I examine significant **product**
introductions from some of the leading CAD vendors who have been dabbling
in GIS. Then I explore some of the sources of data that you can use to
create map databases. Finally, I introduce several new development tools
that promise to enable database application developers to add geographic
data analysis functionality to their applications.
     ESRI, the Granddaddy of GIS
     Founded in 1969, Environmental Systems Research Institute (ESRI) Inc.
has provided GIS solutions longer than any other firm. With its current
 product strategy, ESRI offers a scalable client/server suite of **products**
to manage geographic information, perform geographic analysis, and add
mapping and geographic capabilities to custom applications being developed
with tools that support Microsoft's Activex architecture. At the core of
the ESRI **product** line is the venerable ARC/INFO **product** . Long the
gateway into an organization's geographic information, ARC/INFO has more
recently focused on supporting data acquisition and management and
geographic analysis tasks. ESRI characterizes the ARC/INFO data model as a
"georelational" data model, because it stores vector information in one
format and links it to attributes stored in related tables.
     ARC/INFO lets users collect information about common subjects such as
environmental features or housing stock into "themes," and define the data
that will be stored about each theme. From there, users can define a
"view"--as a collection of themes covering a specific geographic area.
ARC/INFO includes many tools to facilitate the capture of both locational
and attribute information. To support digitization, ARC/INFO offers
utilities that perform the following functions:

* read input created by tracing features on a digitizer tablet
* georeference images to real world coordinates
* coordinate raster with vector presentations
* automate entry of data and attributes from Global Positioning
Satellite (GPS) receivers.

ARC/INFO accepts keyboard entry of coordinate and data values and
imports from a number of external file. formats. To associate data in a
tabular format with existing maps, map database--administrators can key
data elements to a variety of coordinate systems, including x, y, polar,
relative, and street address. To facilitate maintenance of maps in a
dynamic environment, ARC/INFO provides functions to update coverages via
cut-and-paste operations, extract sets of features, merge features, and
perform spatial append and join operations.

In its role as a data manager, ARC/INFO works closely with ESRI's
Spatial Data Engine (SDE). SDE actually runs as a database application.
Although it currently requires Oracle7 (version 7.1.6 or greater), ESRI has
announced plans to ship versions for Sybase and Informix by the end of
1996. SDE works by defining a series of geography-specific data types,
packages, and stored procedures, and by providing an API interface through
which other **products** can access its functionality.

SDE defines three classes containing spatial object types: Point
class objects represent point locations such as utility poles. Linear class
objects support linear paths that pass through (n) connected points. Ring
objects have a common beginning and ending point but no area; they are
useful for representing ring roads. Area class objects represent area
features such as land parcels; of these, the DONUTPOLYGON object enables
SDE to store very complex structures in which multiple areas are embedded
within a surrounding area, like islands within a lake. The SDE
administrator assigns each geographic attribute, such as a winery, the
entrance to a natural area, or an urban quarter section, to a specific
type, and then stores values of the attributes of its particular type in
the database.

Deployment of SDE in an RDBMS enables the GIS to leverage traditional
strengths of the client/server model, including a cooperative processing
architecture, concurrency controls, well-defined APIs to widely available
Windows development tools, a common security model, and support for
multiple widely accepted **product** platforms. It also enables integration
with information stored in existing corporate databases, and it facilitates
formulation of queries that ask questions with both geographic and
traditional business dimensions. In addition to standard SQL query
qualifications, SDE provides over 100 functions to permit specification of
spatial relationships such as size relationships, proximity relationships,
whether features have a common point or boundary, and whether one feature
contains another.

ESRI on the Desktop

On the client side, ESRI **provides** the ArcView and **MapObjects**
products . ArcView is a self-contained desktop geographic analysis package
that ships with over a gigabyte of map and socioeconomic data, including US
boundary maps, cities, highways, census tracts, water courses, Mexican and
Canadian states and provinces, major cities, roads, and a collection of
international maps. ArcView offers sophisticated mapping and analysis
features as well as the ability to generate maps from data in existing
corporate or desktop data stores in ESRI's own SDE or ARC/INFO data stores.

With ArcView, users can assign geographic context to geographic
images such as satellite and aerial photographs, display them as a means of
highlighting vector features, and assign data values to areas within them.
ArcView is highly customizable, developed with a custom development
language that ESRI calls Avenue and claims is object-oriented (although it
clearly provides object references to geographic features, I can't vouch
for how well it supports the core object-oriented triad of inheritance,
encapsulation, and polymorphism).

The entire ArcView menu system and tool bar is customizable, with the
ability to call programs that you write with Avenue from commands that you
add to the system. This open architecture lets ESRI and third-party

developers create plugin modules; ESRI is aiming to kick-start this business by releasing its own plugins. Spatial Analyst, which lets users perform interactive analysis with data that ArcView converts to graphics in raster format, uses a powerful calculation engine to calculate and map rates of change in geographically dependent data (such as concentrations of demographic groups) and to calculate buffer areas whose populations fall within specified limits. The Network Analyst plug-in performs routing analysis, finds the closest facility, and defines service areas based on travel time. These modules exemplify the type of work that has so far been impractical on the desktop. In fact, it was quite exciting to see the **product** respond quickly to queries about where to put facilities and how long it should take to follow its recommended delivery route.

MapObjects is a collection of Activex mapping controls and OLE geographic components that let developers integrate GIS functionality into custom applications they are building for Windows NT and Windows 95. MapObjects provides functions such as panning and zooming through multiple map layers, highlighting the geographic aspect of data with classification patterns, address geocoding, spatial queries and analysis, and tracking realtime events through interfaces to incoming data from live GPS connections. As with ArcView, ESRI supplies a substantial amount of data with MapObjects, including roads, census boundaries, ZIP codes, states, and countries. As part of the ESRI suite, MapObjects-enabled applications can access data stored in ARC/INFO's shapefile format or in SDE, as well as in standard databases via ODBC.

Desktop GIS

My first acquaintance with GIS **products** was with desktop mapping **products** that began to appear in the latter half of the 1980s, particularly the Atlas GIS and MapInfo. These **products** have declined in importance because they failed to provide the power that Engineering users require or the database connectivity and deployment capabilities that corporate decision makers require. Earlier this year, ESRI acquired the Atlas GIS **product** , and the company plans to merge it with its existing ArcView **product** line. **MapInfo** , meanwhile, has taken aggressive steps to provide a more scalable **product** with several deployment options. MapInfo made its initial mark as the mapping tool that worked with dBASE files, riding the coattails of the dBASE data file standard to a leadership position in the desktop mapping arena. MapInfo Professional 4.0 is a 32-bit Windows 95 application that combines the usability, sophistication, and connectivity that makes desktop **productivity** suites so popular.

MapInfo demonstrates its data-oriented heritage by putting a property-sheet-style data view just a short mouse-click away from the active map. In its current incarnation, MapInfo offers the user query wizards that can build SQL statements to query multiple ODBC databases simultaneously. It emphasizes its first-class Windows citizenship by allowing users to drag and drop maps into OLE container applications. (See Figure 1, page 66.) When a user selects a map embedded in a container application, MapInfo negotiates with that application to integrate its menu items into the application's menu system and enable in-place editing of the map. Some features that illustrate MapInfo's sophistication include built-in geo-referencing; autotrace, which automatically traces segments between a shape's vertices; and the ability to identify adjacent maps and support seamless scrolling through them.

Underscoring its appeal for corporate installations where the principal applications require market and site analysis tasks, MapInfo recently announced partnerships with UniSys, Informix, and Oracle. To leverage the spatial data support that the Informix and Oracle database **products**   **provide** , **MapInfo** will provide GIS-specific client-side development tools (highlighted by the MapBasic spatial application development language) and the ability to embed automated MapInfo maps into custom applications developed with OLE 2.0-compatible client/server development tools such as Visual Basic, PowerBuilder, and C++.

Another interesting development in the MapInfo world is the rollout of MapInfo ProServer, the first in a series of MapInfo **product** introductions that will bring map-based applications to the Internet and

corporate Intranets. Rather than install MapInfo on all of the desktops on which some mapping applications will be used, corporate information managers will be able to install MapInfo, custom GIS applications, and the new ProServer component on a server where users will access them from their Web browser, Web pages connect to ProServer via CGI calls that return interactive maps to the browser. Insofar as the maps may themselves be connected to external databases, this connection becomes a powerful means of integrating and presenting corporate data and applications. Based on my discussions with **product** developers and GIS VARs, I expect to see increasing Intranet deployment of GIS over the next 18 months.

GIS Application **Products**

Several vendors provide very specialized and interesting GIS solutions. Organizations that employ field crews to install and maintain outside equipment or respond to service outages have intense, special requirements. The convergence of an evolving set of technologies that enable crews to carry GIS into the field will make it unnecessary for those crews to carry paper maps and documents.

MapFrame Corp. is one of several vendors carving out a niche by providing the baseline technology for realtime, operational mobile GIS applications. The company's Penovation software runs on mobile pen-based computers but supports standard GIS features. MapFrame rejects the idea of adapting a "one size fits all" desktop mapping package to a pen computer. Instead, the company develops application-specific solutions that focus on the requirements of mobile users. Emergency response, utility field operations, resource management, and facilities management are some of the areas that use this highly innovative new technology. MapFrame functions as a systems house, delivering prebuilt modules (defining a variety of mapping, graphics, forms, and database functions), which can be quickly configured for job-specific solutions. Clients, in effect, choose the desired elements for their particular solution.

Smallworld Systems applies object-oriented and distributed version management database technology to the problems faced by organizations--particularly utilities and telecommunications companies--that manage extensive facilities across wide reaches of time and space. Addressing the cost considerations of organizations managing thousands of maps with millions of data points, Smallworld has developed techniques to manage and display both raster and vector data in the same environment. This approach lets users avoid digitizing entire maps. Instead they can scan them in raster form and capture vector information for only the features that are critical to them. Another key technology eliminates the need to split graphics and attributes into separate files, permitting users to capture attributes, geometry, and topology in a single pass over a seamless mapbase.

What makes Smallworld interesting is its efforts to develop solutions to GIS database problems such as long transactions, versioning, and distribution of data. In the application context that Smallworld is trying to address, engineers commonly check out sections of the database to make a set of changes that will take a significant amount of time. Smallworld creates a tree of alternatives to the base information, which can be posted back to the base as they are completed. Smallworld's technology persistently caches data on client workstations, which minimizes network traffic and takes advantage of high-performance engineering workstations. It also supports distributed database access by' teams working in the field or at remote facilities.

CAD Players Introduce GIS **Products** The leading players in the computer-assisted engineering and design markets are increasingly applying their **products** and technology to GIS problems. GIS represents a natural market extension for these firms, because many of its **customers** are civil and environmental engineers whose work revolves around managing utility, building, and **transportation** infrastructures. In fact, engineers have used **products** such as AutoDesks AutoCad and Bentley's MicroStation in mapping applications for years, and vertical developers have supported them with market segment-specific **products** . Only within the past year have these vendors themselves begun to supply GIS extensions to their

underlying automated drawing and design technologies.

Bentley's MicroStation GeoGraphics adds spatial analysis functionality, enhanced database capabilities, and image management tools to the core MicroStation 95 **product** . GeoGraphics highlights a feature-based design that lets users interact with data in terms familiar to them. A feature is a user-defined combination of an element's logical name, graphical symbology, database attributes, and methods. These methods, or operations, define the means by which features are created, modified, and manipulated. Feature-based design transcends layering limitations by permitting many distinct features to exist on one design layer. Using the Feature Group utility, users can define hierarchical organizations of geographic features, which facilitates restriction of the features displayed on a given map and navigation through large, complex feature sets.

Overlay operations, such as polygon intersections or unions, let users discover the spatial relationships among layers of data. Most systems that encode topological relationships among objects store those relationships as a part of their persistent data model; when spatial information changes, these relationships must be recalculated. MicroStation GeoGraphics' spatial engine optionally computes topological relationships on demand, enabling users to create virtual topology layers containing point, line, and polygon data. These topological layers are used to perform spatial operations -such as intersections, unions, and adjacency--that can be filtered using standard SQL query criteria. MicroStation GeoGraphics' SQL Manager lets users locate, display, and edit database information associated with map features. MicroStation's database connectivity tools, including MicroStation 95's new ODBC capabilities, enable users to create and manage links among map features as well as non-graphical attributes that can be stored in any ODBC-compliant database.

Map creation highlights the usability and precision of MicroStation's drawing tools; it also exposes the underlying capabilities of its CAD engine. Users can create a wide variety of maps using the comprehensive set of data-driven thematic tools, which let them associate symbols, area fills, and patterns with data attributes. User-defined settings control the specification and positioning of map labels.

Inconsistencies in map and data sets are the bane of GIS applications; such inconsistencies can easily cause analytical operations to produce inaccurate results. GeoGraphics' suite of geometric cleanup and validation tools find and fix duplicate and similar linework, endpoint gaps, intersections, dangling lines, and fragments based on user-defined tolerances.

Based on surveys that indicate that 10 percent of its user base is using AutoCAD for GIS applications, AutoDesk claims the largest installed base of GIS users. As the leading CAD supplier, AutoDesk has certainly established its DWG and DWF file formats as standards for engineering documents. Most GIS **products** acknowledge the role that AutoCAD has played in the drawing world by providing DWF file-import capabilities. In 1996, Autodesk initiated programs to focus explicitly on the GIS market, starting with the creation of a GIS Market Group and the introduction of the first AutoDesk branded GIS extension, AutoCAD Map. In the fourth quarter, the company released a client/server suite of Internet mapping tools called MapGuide.

AutoCAD Map performs map generation and analysis within the DWG file format, and it imports and exports .MIF/. MID (MapInfo), .SHP (ESRI), .DXF, and .DGN (Intergraph) files. In addition, AutoCAD Map will link to external Oracle-, .DBF-, and ODBC-compliant databases. The **product** boasts robust **map** creation and editing tools, including support for digitizing, rubber sheeting, and multiuser editing; extensive cleanup and thematic mapping capabilities; and geographic analysis features that utilize GIS topology such as polygon overlay, buffering, and network analysis.

AutoCAD Map is the first release of a **product** line that will provide client-side tools for developing geographic database applications. These tools will work in conjunction with corporate databases stored in traditional RDBMSs, object DBMSs, and the emerging Object-Relational DBMSs.

This strategy will enable the firm to leverage its sophisticated map
creation and refinement tools. By offering accessible graphical analysis
tools, AutoDesk hopes to extend the reach of GIS **products** into the realm
of a much wider range of business decision makers.

In contrast, the MapGuide **product** line, which AutoDesk acquired
from Argus Corp., consists of a map server with protocols and file formats
optimized for access from an HTTP (Web) server, an authoring tool for
designing GIS applications that run on Web sites, and a Netscape plug-in
for viewing maps. By deploying GIS applications as plug-in applets running
in an Intranet environment, AutoDesk's GIS **product** line delivers specific
analysis tasks to the business analysts who need to use them.

The Data Dimension

This interesting technology doesn't solve problems by itself; you
also need geographic data. There are several ways to acquire digitized maps
and data. As mentioned earlier, a number of GIS **products** come with
significant data sets. Much of this data is repackaged data generated by
the U.S. government, one of the world's largest producers of location-based
data and maps. The federal government's low-cost distribution of geographic
data -and particularly the Census Bureau's adoption of TIGER (Topologically
Integrated Geographic Encoding and Referencing) files for the 1990
census--has been a key trigger to the explosive growth of the GIS industry.
TIGER data sets include street maps, boundary maps, and population counts.

The other significant government **provider** of **map** information is
the U.S. Geological Survey (USGS). USGS maps depend heavily on surveying
and aerial photography techniques, which yield geographic accuracy and
feature-classification data but no other attribute information. The first
of two principal types of USGS maps is Digital Line Graphs (DLGs), which
are computer representations of traditional USGS paper maps created from
1:2,000,000, 1:100,000, and 1:24,000 scale maps. DLG maps are available for
11 information layers, including roads, railroads, power lines, pipelines,
water features, and elevation contours. The second important USGS category
is Digital Elevation Models (DEMs), which are raster representations of
surface elevations. The advantage of obtaining federally generated maps
with your GIS **product** is that the vendor has already done the work of
porting the maps into the **product** 's **map** and data format, and has
rectified information from varying data sets into a common resolution and
coordinate system.

A number of third-party providers also offer government data in
value-added form, often in conjunction with data that they collect
themselves or acquire from other parties. Among the leading vendors of
market intelligence data and specialized business mapping applications are
Claritas and Equifax National Decision Systems. These companies offer a
wide range of data **products** primarily oriented to marketing decision
makers in specific industries. For instance, they offer specific data sets
for the finance and insurance industries, the real estate industry, and the
restaurant industry. These data sets help users perform several tasks
including segmenting and locating target groups of consumers, planning
marketing, advertising, and mail list expenditures, mapping actual versus
potential **product** usage, and evaluating business locations and trade
areas. The data **products** offered by these firms include detailed name,
location, and type information for over 500,000 restaurants in 54
categories. Other facts provided include statistics on home purchases and
improvements, refinancing, comparisons of loan origination and denials to
family income, and sales by census tract.

Equifax National Decision Systems offers heavily customized versions
of ESRI's ArcView GIS analysis **product** , which it re-markets under its own
label as Sparta. Sparta comes in several industry-specific flavors. For
example, Sparta MarketManager comes with consumer demand data for specific
market areas, and it permits users to enter their own historical sales data
by **product** or **customer** category. It then performs analysis to generate
custom maps and reports for specific brands, categories, and **retail**
locations. Another **product** , Sparta CRA, is targeted at banks and supports
compliance with Community Reinvestment Act reporting requirements. It lets
bank analysts define assessment areas and map income distribution against

loan/deposit ratios, consumer loans, home loans, and small business loans.

Geographic Data Technology Inc. (GDT) develops and sells geographic digital street network and boundary databases, geocoding software, and custom geographic services. The company is a leading supplier of geographic data to major GIS and desktop mapping vendors. Geographic Data Technology's Address Geocoding Service links addresses in address files to actual points on the globe. GDT provides **customer** and demographic data that organizations can use to perform several types of analyses. These analytical studies include market penetration studies, cluster evaluation, sales effectiveness studies, community reinvestment act analysis, creating target zones, and scheduling and routing applications. GDT's nationwide geocoding software, Matchmaker/2000 for Windows, attaches latitude/longitude coordinates and Census codes to address lists. Matchmaker is a simple, easy-to-use application that includes both software and GDT's comprehensive street database. Geocoded addresses can be analyzed, grouped, and displayed with any Desktop Mapping or GIS application. Dynamap/2000, GDT's premier nationwide street centerline database, includes over 13.5 million addressed segments with improved street classification codes, industry-standard five-digit ZIP code boundaries, census tracts, and block groups.

A company called MaconUSA is taking another angle at the data marketplace. MaconUSA has assembled over 1000 maps generated by public agencies around the world into a format readable by the Microsoft Excel 7.0 mapping feature, and it has published them on a single CD-ROM. It dubbed this package Maps and Data for Microsoft Office 95 and is offering it for about $100 per CD in an effort to obtain market share quickly. Excel's data mapping feature puts modest GIS capabilities on vast number of desktops compared to the penetration of true GIS **products** . The availability of low-cost data supplied in that format could trigger much more widespread understanding and acceptance of GIS applications. MaconUSA also offers worldwide map data in standard GIS formats such as ARC/INFO, ArcView, and MapInfo. The MaconUSA map offering is notable for the international breadth of its geographic coverage as well as its aggressive pricing, again used as a tactic to expand the marketplace for mapping data.

Developing Custom Mapping Applications

Several Web sites draw a map illustrating the location of a person or business given an address that you enter. (I discuss some examples later.) These sites have done much to broaden the awareness of mapping technology and promote its applicability to everyday applications. Interestingly, most of these sites are built not around the established **products** that I have been discussing, but around special-purpose map servers and lean mapping engines. **Products** of interest include GeoSystems' MapQuest Internet Mapping server, Etak's family of maps and development tools, Sylvan Ascent's Sylvan Maps/OCX, and the WinMAP family of tools from ProGIS.

MapQuest has developed mapping technology optimized for deployment over the Internet. Given an address, MapQuest geocodes it, draws a map, and converts it to a small GIF file--all in an amount of time that can be counted in tens of milliseconds. This technology is geared to high-volume applications such as trip planning or finding the location of a specific business. Consumers can access MapQuest's mapping engine on the company's Web site at www.mapquest.com; at the site, you can register and create a personalized map portfolio.

MapQuest provides customization tools that let companies develop specialized mapping pages with regions that indicate where the required map will be drawn. When the browser requests a map, the participating company's Web server forwards the request to the MapQuest server, which draws the map and delivers it to the browser that requested it. Applications built this way can truly be called distributed applications. Well-known Web sites that use this technology include Volkswagen (www.volkswagen. com) and Bigbook (www.bigbook.com). When you request information that includes a map from one of those sites, the site returns any textual information itself and forwards the map request to MapQuest, whose mapping engine creates and sends the required map to your browser.

Etak offers high-quality digital road maps and supporting software. The firm can supply developers with a set of programming tools to retrieve and display maps within their applications. Incorporated as a set of C-language libraries, Etak MapAccess Software Development Tools facilitate rapid integration of Etak mapping technology. The resulting **products** include customized interfaces and extremely rapid database access times. Etak's suite of Internet applications includes E-Map View, E-Map Route, and E-Map Locate. E-Map View enables Web publishers to geo-enable a Web site, generating detailed, scalable maps of areas specified by the publisher. The **product** includes Etak's nationwide digital map database, a map server to generate the maps, customization tools, and a CGI interface. E-Map Route adds routing capabilities. E-Map Locate is a standalone **product** designed for creating Web sites where browsers can enter an address and get a map of the location in response.

WinMAP SDK from PROGIS lets developers incorporate GIS functionality into custom database applications. Headquartered in Austria, PROGIS has a decidedly international flavor, conducting most of its business in Europe. In early 1996, the firm announced that IBM Eastern Europe would market and sell the WinGIS **product** family as IBM PC-GIS solutions. Because the SDK is built around the Windows DDE API, it requires that the selected development tool have DDE client capabilities. This architecture leverages the 16-bit Windows platform that still represents a substantial portion of the PC-installed base. The SDK includes a runtime version of the ProGIS WinMAP **product** ; the custom application will interact with the runtime version, typically giving it instructions about what map to draw and where to plot points that illustrate values from the database.

The SylvanMaps/OCX employs more interesting technology to solve the problem of embedding a GIS engine in a custom application. (See Figure 2.) As an OCX, the control exposes its properties, methods, and events to any OLE/ActiveXcompliant development environment. SylvanMaps/OCX connects to any ODBC-compliant data source and expects to find data in tables with prescribed table naming conventions and coverage information. Each coverage consists of a collection of polylines, polygons, and points. The OCX lets developers combine multiple coverages in multiple layers and control symbol properties.

Some Final Thoughts

I started working on this two-part series on GIS in July 1996. Since that time, the industry has made significant strides forward. The increasing deployment of mapping engines such as those supplied by Map-Quest and Etak have done a great deal to raise consciousness about mapping and geographic applications among users. And now that they have had a taste of mapping, I expect those users to demand increasingly rich functionality. Technology developers with database and CAD system backgrounds, as well as companies that have focused on GIS problems throughout their lifetimes, wait in the wings to provide that functionality. As we move forward, companies such as MapQuest that started out by developing a high-powered mapping engine will add more GIS-like features (such as map maintenance and analysis) and will start to challenge the more established GIS players.

You're left with a plethora of choices for developing GIS applications. I sympathize if you find that this survey, although it offers a great deal of information about the range of choices, has done little to help you select one appropriate to your application requirements. So here are some evaluation guidelines: If your application has a facilities management or engineering orientation, start by looking at the **products** that come from the CAD environment, as well as special-purpose **products** such as SmallWorld. For general-purpose, all-in-one geographic analysis functions, tools in the ESRI and MapInfo **product** lines are likely to fill the bill. Of the two, ESRI offers more breadth and depth, and the stronger suite of map creation tools. MapInfo has a very strong database orientation, a highly refined user interface, and an early set of Intranet GIS tools. For embedding GIS functions in your custom applications, look at MapObjects from ESR1 and Sylvan Ascent's SylvanMaps/OCX.

With the exception of SmallWorld, the **products** I have discussed

this month are client side **products** . They operate effectively in conjunction with the database **products** I discussed in Part 1 in November. Some very close relationships are emerging between the client tools and GIS server technologies. For instance, ESRI is closely integrated with Oracle RDBMS **products** and with IBM DB2 **products** . **MapInfo** has worked closely with Informix, developing applications on the New Era server platform as well as an address DataBlade for the InformixUniversal Server. From any segment's perspective, the GIS industry has expanded rapidly during the past year (as evidenced in Table 1, page 67). Whatever the size of your organization and the scale of your applications, tools are now available that should fulfill your requirements.

(TABULAR DATA OMITTED)

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SPECIAL FEATURES: illustration; table
COMPANY NAMES: Environmental Systems Research Institute Inc.-- **Products**
DESCRIPTORS: Technology Overview; Geographic Information System; Programming Utility
SIC CODES: 7372 Prepackaged software
TRADE NAMES: ARC-INFO (Geographic information system)--Design and construction; MapObjects (Programming utility)--Design and construction
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01543095   Supplier Number: 47470252   (USE FORMAT 7 FOR FULLTEXT)
  Visio Unveils Easy-to-Use Desktop Mapping Product .
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Document Type: Newswire; Trade
Word Count: 1335

   Visio Unveils Easy-to-Use Desktop Mapping Product .
...   Data to Deliver A Complete Solution for Creating and Sharing
Data-Rich Geographic Maps
     Visio Corp. (NASDAQ "VSIO") today announced at PC Expo its new
 product Visio(R) **Maps** , a desktop mapping software **product** that allows
users to create, share and distribute high-quality, data-rich maps quickly
and easily.
     Designed for the needs of users who are not...

...corporations recognize the need for map-based data to analyze trends,
patterns and relationships for better decision-making," said Gary Gigot,
vice president of worldwide **products** at Visio. "Because Visio software is
a visualization tool, its technology can be extended naturally to the GIS
market, which will take the current use...

...the realm of academic research to markets such as government,
environmental and utilities services and now, into mainstream business
usage. Worldwide sales for GIS software **products** indicate growth at an
annual rate in excess of 13 percent, and sales are likely to top the $1.3
billion mark by the end...

...its well-known ease of use and power to a market category that until now
has been dominated by difficult and expensive software packages. These
 products have traditionally required the user to be a GIS specialist, and
cost more than $1,000. Visio Maps is designed for the more than 1...

...do not create, GIS maps; and software developers who can use Visio Maps
as a development platform.
     "I haven't used a GIS desktop mapping **product** , but I can see its
value," said Richard Reis, distributed systems architect at a large
telecommunications company. "I am looking forward to a **product** that will
permit me to easily create maps showing user and system locations. I
appreciate Visio's easy-to-use interface and its capability to connect and
align shapes.
     About Visio Maps
     An add-on to Visio software **products** , Visio **Maps** allows users to
take advantage of the same familiar user interface and SmartShapes(R)
symbols that are available in Visio, Visio Professional and Visio
Technical. In addition, Visio **Maps** provides more than 120 new SmartShapes
symbols for **transportation** , recreation, buildings and facilities, oil,
gas and water, weather and forecasting, as well as general-purpose labels
such as legends.
     The **product** also **provides**   **mapping** features offered by high-end
GIS tools, including thematic shading of data, address-matching to street
level, the ability to find locations by data, and...

...and Borland dBASE, in standard data file formats, thus enabling users to
add and manipulate their own information within maps.

With demographic and geographic data **provided** by ESRI, Visio **Maps** provides data sets -- including country, state, major city, major county, five- and three-digit ZIP code area, area of dominant influence (ADI), Census Tract, and...

...solution for companies of all sizes," said Jack Dangermond, founder and president of ESRI. "By using our MapObjects code and providing compatibility with our ArcView **product** , Visio gives ESRI's GIS-specialist **customers** the unique ability to share maps with every individual in their organizations. This will dramatically increase their **productivity** and reinforce the importance of visualizing geographic data in business applications."
    Using Visio Maps
    The potential use of Visio Maps spans many industries:
    -- A network...

...Pricing and Availability
    Visio Maps will be available in August 1997 directly from Visio Corp., as well as from leading national distributors, corporate resellers and **retail** channels. The **product** is a 32-bit application designed to work with 32- ...5. Visio Maps will have a U.S. estimated street price of $199. To place an order or to obtain more information on any Visio **product** , **customers** can contact Visio at 800-24-VISIO (248-4746), ext. 93W. Additional details about Visio can be obtained on CompuServe (GO VISIO) or Visio's...

...based company pioneered the drawing and diagramming market with the release of Visio 1.0 in November 1992 and has since released additional Windows-based **products** for the creation and exchange of drawings and diagrams in business. Visio's powerful **product** architecture, combined with partner programs and third-party relationships in key market segments, is establishing Visio as a desktop platform standard for the creation of graphical solutions. The company markets the Visio **product** line in nine languages and in more than 35 countries with more than 1 million users throughout the world.
    About ESRI
    ESRI was founded in...
EVENT NAMES: 336 (**Product** introduction)
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